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on Quality of
Prepackaged Vacuum-Cooled Cauliflower

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EFFECTS OF CHEMICAL TREATMENT ON QUALITY OF PREPACKAGED VACUUM-COOLED CAULIFLOWER

By J. Kaufman, M. Ceponis, and J. Michelstein[1]

Tests have shown that cauliflower can be packaged[2] and vacuum cooled successfully.[3] Prepackaging is increasing in New York State and in other areas. Receivers and grower-packers, however, have felt that more work should be done to prevent discoloration and decay found in many lots on arrival, especially in delayed shipments. At their request, tests were started to determine whether the fresh appearance of prepackaged cauliflower can be maintained for longer periods by chemical treatments before vacuum cooling.

Methods and Materials

Three tests were conducted during July and August 1962, with the Snowball variety of cauliflower, grown near Stamford, N. Y. The heads were harvested, partially trimmed in the field, and placed loosely into field crates. They were then carted to the packing shed, where most of the remaining leaves were removed, leaving only a few basal leaves. At this point, the heads to be tested were removed from the commercial lots and randomized. Nine to fifteen heads per treatment were then dipped in the aqueous solutions tested, for 1 minute, or as directed by the manufacturer (table 1). The solutions tested were sodium hypochlorite (100 parts per million of chlorine), sodium acid sulfite (1 percent), a commercial sulfite, and acetic acid (1 percent). Nontreated dry heads and heads dipped in plain water were used as controls. The lots were drained, wrapped in perforated cellophane, heat-sealed, and packed in perforated cartons.

TABLE 1.--Effect of chemicals on appearance and curd color of prepackaged, vacuum-cooled cauliflower[1]

Periods	Vacuum cooling only[2]		Sodium hypochlorite 100 ppm Cl		Sodium acid sulfite 1.0 percent		Commercial sulfite[3]		Acetic acid 1.0 percent	
	Rating		Rating		Rating		Rating		Rating	
	Head	Curd	Head	Curd	Head	Curd	Head	Curd	Head	Curd
At origin	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
At destination	4.5	4.5	4.5	4.5	4.4	4.4	4.3	4.5	4.1	4.7
After 3 days at 45° F	4.0	4.1	4.0	4.2	3.5	4.1	3.9	4.2	2.9	4.0
After 7 days at 45° F.	3.4	3.6	3.6	3.7	2.8	3.5	3.4	3.5	2.4	3.2
After 14 days at 45° F	2.8	3.4	2.7	3.3	2.4	3.1	2.4	3.4	2.3	3.2

[1] Rating scale: Very good = 5, good = 4, fair = 3, poor = 2, very poor = 1; each figure is an average of 15 to 24 heads (3 tests). "Head" = curd plus few basal leaves.

[2] Average of wet and dry heads.

[3] Prepared as directed by the manufacturer, the preparation reported to consist of sulfite, ascorbic acid, citric acid, sodium carbonate, and dextrose.

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[2] See: Kaufman, J., Friedman, B. A., and Hruschka, H. W. 1948. Prepackaging of Long Island Broccoli, Brussels Sprouts, and Cauliflower. Pre-Pack-Age 1(11): 10-13.

[3] See: Stewart, J. K., and Barger, W. R. 1961. Effect of Cooling Method on Quality of Asparagus and Cauliflower. Amer. Soc. Hort. Sci. Proc. 78: 295-301.

The cartons of cauliflower were then vacuum cooled in a commercial cooler operated by a mechanical pump system. Before vacuum cooling, thermocouples were inserted into cauliflower curds, and temperature readings were taken manually with a potentiometer during the vacuum cycle. After vacuum cooling, the packages were placed in a cold room for 1 to 3 days until shipped in a refrigerated truck 180 miles to New York City.

Each of two cartons in each test shipment contained two small recording thermometers that recorded temperatures from the time the heads were vacuum cooled until the thermometers were recovered and brought to the New York City laboratory. At the laboratory, the heads were examined for appearance, curd color, bruising, and decay. Inspections were made on arrival and after holding 3, 7, and 14 days at 45° F. Quality was rated on an arbitrary scale ranging from 5 (very good) to 1 (very poor).

Results and Discussion

Temperature Changes.--Cauliflower temperatures in the three tests averaged 67° F. before vacuum cooling. After vacuum-cooling cycles of 40 to 50 minutes (with minimum pressures of 4.0 to 4.6 millimeters of mercury), the temperatures averaged 42° (range 36° to 51°). Variations in air and commodity temperatures during a vacuum cycle had been observed previously with other commodities.[4]

In the cold room and in transit, the average cauliflower temperatures ranged from 42° to 51° F. (table 2); at destination, the range was from 42° to 49°. The desirable temperature range for holding cauliflower is 32° to 40°.

TABLE 2.--Temperatures of prepackaged cauliflower before and after vacuum cooling and in transit from Stamford, N.Y., to New York, N.Y.

Test number	Temperature before vacuum cooling	Temperature after vacuum cooling		Cycle	Temperature in cold room	Transit temperature[1]
	Average °F	Average °F	Range °F	Minutes	Average °F	Average °F
1	68	45	42-51	40	51	43 (40)
2	69	39	36-47	45	42	48 (45)
3	65	41	36-51	50	42	50 (50)

[1] The figures in parenthesis were the settings of the thermostats on the trucks.

Quality Changes.--Because differences between the dry and wet (dipped) heads were slight, the data were combined. Generally the vacuum-cooled, nontreated heads were rated as good to very good on arrival and held up well for an additional 3 days at 45°. Appearance was, however, considered only fair to good after 7 days and was poor after 14 days.

The chemical treatments did not prolong the shelf life of vacuum-cooled cauliflower (table 1). Two of the chemicals, sodium acid sulfite (1.0 percent) and acetic acid (1.0 percent), caused visible injury to the curds (pitting) and to the basal leaves (discoloration).

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[4] See: Friedman, B. A. 1951. Vacuum Cooling of Prepackaged Spinach, Coleslaw, and Mixed Salad. Amer. Soc. Hort. Sci. Proc. 58: 279-287.

The chemicals used in these tests had appeared promising either with segmented cauliflower[5] or with other commodities.[6]

The effect of the chemicals on decay could not be ascertained because decay, even after 14 days, was slight.

Bruising.--Trace to slight amounts of bruising were noted in about 40 percent of the heads. The bruised areas, mostly under 1/2 inch in diameter, were white, watersoaked, and not conspicuous during the first 3 days at 45° F. Discoloration of bruises became apparent after 3 to 7 days.

Summary and Conclusions

These tests were conducted with prepackaged cauliflower cooled in a commercial mechanical vacuum cooler. The average temperature of prepackaged cauliflower in cartons was reduced from 67° to 42° F. during vacuum cycles of 40 to 50 minutes. During transit, the average temperature of the heads rose 5 degrees. After 3 days at 45°, discoloration of bruises lowered the quality of the heads.

The various chemical treatments did not improve the appearance of the heads during a 2-week holding period at 45° F.

Acknowledgment

Todd Farms, Stamford, N.Y., provided the cauliflower and the facilities for preparation treatment and vacuum cooling.

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[5] Kaufman, J. 1957. Unpublished data: Chemical treatments of segmented califlower. Horticultural Crops Branch, New York City.

[6] See: Kaufman, J. 1961. Parsnips: Refrigeration Is Key to Offering Peeled and Sliced Packaged Parsnips, but Chemical Dip Adds ShelflLife. Produce Marketing 4(5): 25-26.

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